

OVERWEIGHT, OBESITY AND ASSOCIATED FACTORS AMONG 13-15 YEARS OLD STUDENTS IN THE ASSOCIATION OF SOUTHEAST ASIAN NATIONS MEMBER COUNTRIES, 2007-2014

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Abstract. The aim of this study was to assess overweight or obesity and associated factors in school-going adolescents in the Association of Southeast Asian Nations (ASEAN) member countries. The analysis included 30,284 school children 13-15 years of age from seven ASEAN members participating in the Global School-based Student Health Survey (GSHS) between 2007 and 2013. The overall prevalence of overweight or obesity across seven ASEAN countries (excluding Brunei) was 9.9%, significantly higher in boys (11.5%) than in girls (8.3%). Among eight ASEAN countries, the highest prevalence of overweight or obesity was in Brunei Darussalam (36.1%), followed by Malaysia (23.7%), and the lowest was in Myanmar (3.4%) and Cambodia (3.7%). Multivariate logistic regression analysis found that younger age, coming from an upper middle country, never been hungry, and not walking or biking to school were associated with overweight or obesity. In addition, among boys, having three or more servings of vegetables per day and having no close friends, and among girls, having fast foods two or more times per week, been victims of bullying and having peer support were additional factors associated with overweight or obesity. Increased strategies utilizing a number of the risk factors identified are needed to prevent and treat overweight or obesity in adolescents in ASEAN member countries.

Keywords: dietary behavior, global school-based health survey, obesity, overweight, physical activity, psychosocial factor, sedentary behavior, socio-familial factor, substance use, ASEAN

INTRODUCTION

Prevalence of adolescent overweight and obesity is increasing in high-, middle-

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and low income countries (Atienza, 2014; Jaacks *et al*, 2015; Lobstein *et al*, 2015); and in Southeast Asian and Western Pacific regions a prevalence of 10%-20% was found (Wang and Lim, 2012). The development of overweight and obesity during childhood and adolescence have negative health effects, which can continue into adulthood (Reilly and Kelly, 2011). In order to assess and monitor the prevalence

of overweight and obesity of adolescents it is important to plan effective intervention strategies and to evaluate the impact of such policy strategies (De Onis and Lobstein, 2010).

Only a few studies, in particular national representative ones, on overweight or obese adolescents have been conducted in the Association of Southeast Asian Nations (ASEAN) member countries. In a national population-based study conducted in Malaysia in 2004, a 6.5% prevalence of obesity was found in 15 to 19 year olds (Rampal *et al*, 2007). In later local school surveys among adolescents in Malaysia, 19.5% of students were overweight and obese (Rezali *et al*, 2012) and in another study, 10.8% of male and 7.4% of female adolescents were obese (Su *et al*, 2014). In a nationally representative population sample of Thai children, prevalence of overweight and obesity among 3 to 18 year olds was 7.6% and 9.0%, respectively (Jitnarin *et al*, 2011); and using data collected from children 6 to 14 years of age in the Fourth Thai National Health Examination Survey, the prevalence of overweight in girls was 16% (Mo-Suwan *et al*, 2014). Prevalence of overweight and obesity among school children in Ongkharak, Nakhon Nayok Province, Thailand was 12.8% and 9.4%, respectively (Rerksuppaphol and Rerksuppaphol, 2010). In several local studies in urban schools in Vietnam, 4.9% of students were overweight and 0.6% were obese (Tang *et al*, 2007). Nguyen *et al* (2013) found a prevalence of overweight and obesity of 17.8% and 3.2%, respectively, and Trang *et al* (2012) found that within a 5-year period, prevalence of overweight or obesity increased from 14.2% to 21.8%. In school adolescents in Indonesia, prevalence of obesity was 10.2% among urban and 6.5% among rural students (Collins *et al*, 2008).

As reviewed by Pengpid and Peltzer (2015), factors associated with overweight and/or obesity in adolescents may include: (1) sociodemographic factors, *viz.* male gender and younger age; (2) dietary behavior and substance use, including consumption of sugar-sweetened beverage, frequent fast food consumption, lack of fruit consumption, not feeling hungry, and smoking; (3) physical inactivity and sedentary behavior; (4) psychosocial factors such as bullying victimization; and (5) social-familial factors. These risk factors may be different in The Association of Southeast Asian Nations (ASEAN) member countries. Therefore, this study assessed overweight or obesity and associated factors among school-going adolescents in ASEAN members from 2007 to 2014.

MATERIALS AND METHODS

Description of survey and study population

This study involved secondary analysis of existing data from the Global School-based Student Health Survey (GSHS) from seven ASEAN members (Cambodia, Indonesia, Malaysia, Myanmar, Thailand, The Philippines, and Vietnam), from which GSHS datasets were publicly available and could be accessed online (CDC, 2015). A two-stage cluster sample design for selecting schools and then classes was used to collect data to represent all students in grades 6-10 in each country (CDC, 2015). Students independently completed the questionnaire under supervision of trained research assistants (CDC, 2015).

Measures

The study variables used were from the GSHS (CDC, 2015) and are described in Table 1. Body weight and height were recorded by self-report. International age- and sex-specific child body mass

index (BMI), calculated as weight/height² (kg/m²), cut-points were used to define overweight and obesity (Cole *et al*, 2000). School children are categorized as overweight or obese if their BMI was > +1 SD and > +2 SD, respectively from the median for BMI for age and sex (Cole *et al*, 2000). Adequate fruit consumption is defined as two or more servings a day and adequate vegetable consumption as three or more servings a day (CDC, 2013). Inadequate physical activity is defined as obtaining less than 60 minutes of physical activity per day on at least 5 days per week (Prochaska *et al*, 2001; Guthold *et al*, 2010). Sedentary behavior is defined as spending 3 or more hours per day sitting (Guthold *et al*, 2010).

Data analysis

STATA software version 13.0 (Stata Corporation, College Station, TX) was used for data analysis, taking into account the sampling design. Each country sample was restricted to 13 to 15 years age group so as to be able to compare study samples across countries. Associations among socio-demographics, dietary behavior and substance use, physical activity, psychosocial and social-familial factors with overweight or obesity among school children were evaluated by calculating odds ratios (ORs). Logistic regression was employed to estimate the impact of independent variables on overweight or obesity (binary dependent variable) separately for boys and girls. Independent variables found significant in relation to the outcome variables on bivariate analysis were included in the final multivariate model. In the analysis, weighted percentages are reported. The reported sample size reflects the sample that was asked the target questions. A *p*-value < 0.05 is considered statistically significant, and both the *p*-value

and the reported 95% confidence interval are adjusted for the multi-stage stratified cluster sample design of the study.

RESULTS

Sample characteristics

The total sample included 30,284 school children aged 13 to 15 years old from seven ASEAN member states. The sample size in individual countries ranged from 1,734 in Cambodia to 16,095 in Malaysia, of whom 14,750 (48.5%) were boys and 15,430 (51.5%) were girls, with an overall mean age of 14.1 ± 0.8 years (Table 2).

Prevalence of overweight and obesity

The overall prevalence of overweight or obesity across the seven ASEAN countries (excluding Brunei) was 9.9%, significantly higher among boys (11.5%) than among girls (8.3%) (*p* < 0.001). Among eight ASEAN countries with the highest prevalence of overweight or obesity was in Brunei Darussalam (36.1%) and Malaysia (23.7%) and the lowest in Myanmar (3.4%) and Cambodia (3.7%) (Table 3). Although in all countries except Cambodia the prevalence of overweight or obesity was higher among boys than among girls, this is only significant in Malaysia and Thailand. Descriptive statistics of the independent variables are given in Table 4.

Factors associated with overweight or obesity

Multivariate logistic regression analysis revealed that among both boys and girls younger age (13 years), coming from an upper middle country, never been hungry, and not walking or biking to school were associated with overweight or obesity (Table 5). In addition, among boys, having three or more servings of vegetables per day and having no close friends, and among girls, having fast food two or more

Table 1
Description of variables.

| Variable | Question | Response option |
|---|--|---|
| Height | "How tall are you without your shoes on?" | |
| Weight | "How much do you weigh without your shoes on?" | |
| Dietary behavior and substance use | | |
| Carbonated soft drinks | "During the past 30 days, how many times per day did you usually drink carbonated soft drinks such as Pepsi, Seven-up, Fanta, Coke, etc." | 0 = I did not drink any carbonated soft drinks in the past 30 days to 6 = 5 or more times per day |
| Eating food from a fast food restaurant | "During the past seven days, on how many days did you eat food from a fast food restaurant, such as country specific examples?" | 0 to 7 days |
| Fruits | "During the past 30 days, how many times per day did you usually eat fruit?" | 1 = I did not eat fruit during the past 30 days to 7 = 5 or more times per day |
| Vegetables | "During the past 30 days, how many times per day did you usually eat vegetables?" | 1 = I did not eat vegetables during the past 30 days to 7 = 5 or more times per day |
| Hunger | "During the past 30 days, how often did you go hungry because there was not enough food in your home?" | 1 = never to 5 = always |
| Current smoking cigarettes | "During the past 30 days, on how many days did you smoke cigarettes?" | 1 = 0 day to 7 = all 30 days |
| Current other tobacco use | "During the past 30 days, on how many days did you use any other form of tobacco, such as chewing tobacco leaves?" | 1 = 0 day to 7 = all 30 days |
| Current alcohol use | "During the past 30 days, on how many days did you have at least one drink containing alcohol?" | 1 = 0 day to 7 = all 30 days |
| Physical activity | | |
| Physical activity | Leisure time physical activity was assessed by asking participants: "Physical activity is any activity that increases your heart rate and makes you get out of breath some of the time. Physical activity can be done in sports, playing with friends, or walking to school. Some examples of physical activity are running, fast walking, biking, dancing, football. Do not include your physical education or gym class." "During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?" | 0 = 0 day to 8 = 7 days |
| Walking/biking to school | "During the past 7 days, on how many days did you walk or ride a bicycle to or from school?" | 0 = 0 to 7 = 7 days |
| Sedentary behavior | Leisure time sedentary behavior was assessed by asking participants about the time they spend mostly sitting when not in school or doing homework: "How much time do you spend during a typical or usual day sitting and watching television, playing computer games, talking with friends, or playing cards?" | 1 = less than 1 hour per day to 3 = 3 to 4 hours per day to 6 = 8 or more hours a day |
| Physical education | "During this school year, on how many days did you go to physical education (PE) class each week?" | 1 = 0 day to 6 = 5 or more days |

Table 1 (Continued).

| Variable | Question | Response option |
|------------------------------------|---|------------------------------|
| Psychosocial factors | | |
| Close friends | "How many close friends do you have?" | 1 = 0 to 4 = 3 or more |
| Lonely | "During the past 12 months, how often have you felt lonely?" | 1 = never to 5 = always |
| Suicidal ideation | "During the past 12 months, did you ever seriously consider attempting suicide?" | 1 = yes, 2 = no |
| Bullied | "During the past 30 days, on how many days were you bullied?" | 1 = 0 day to 7 = all 30 days |
| Social-familial factors | | |
| Peer support | "During the past 30 days, how often were most of the students in your school kind and helpful?" | 1 = never to 5 = always |
| Parental or guardian supervision | "During the past 30 days, how often did your parents or guardians check to see if your homework was done?" | 1 = never to 5 = always |
| Parental or guardian connectedness | "During the past 30 days, how often did your parents or guardians understand your problems and worries?" | 1 = never to 5 = always |
| Parental or guardian bonding | "During the past 30 days, how often did your parents or guardians really know what you were doing with your free time?" | 1 = never to 5 = always |

Table 2

Details of participating country samples included in the analyses (13-15 years of age).

| Country | Study year | Country income level ^a | Urban population ^b , % | Overall response rate, % | Sample size | Male % | Age (years) Mean (SD) |
|-------------|------------|-----------------------------------|-----------------------------------|--------------------------|-------------|--------|-----------------------|
| Cambodia | 2013 | LI | 21 | 85 | 1,734 | 49.1 | 14.1 (0.8) |
| Indonesia | 2007 | LMI | 53 | 93 | 2,867 | 49.5 | 13.9 (0.7) |
| Malaysia | 2012 | UMI | 74 | 89 | 16,095 | 49.5 | 14.0 (0.8) |
| Myanmar | 2007 | LMI | 34 | 95 | 1,983 | 50.0 | 13.9 (0.8) |
| Philippines | 2011 | LMI | 44 | 82 | 3,640 | 48.3 | 14.1 (0.8) |
| Thailand | 2008 | UMI | 49 | 93 | 2,223 | 49.2 | 13.9 (0.8) |
| Vietnam | 2013 | LMI | 33 | 96 | 1,742 | 46.6 | 14.5 (0.5) |
| All | | | | | 30,284 | 48.5 | 14.1 (0.8) |

^aWorld Bank (2015). ^bWorld Bank (2016). LI, low income; LMI, lower middle income; UMI, upper middle income.

times per week, bullying victimization and peer support were additionally associated with overweight or obesity.

DISCUSSION

The overall prevalence of overweight or obesity was 9.9% (8.3% among girls and

11.5% among boys) across seven ASEAN countries, with a large country variation, ranging from 36.1% in Brunei Darussalam to 3.4% in Myanmar. These findings on the whole are comparable with previous studies in the region (Rampal *et al*, 2007; Tang *et al*, 2007; Rerksuppaphol and Rerksuppaphol, 2010; Jitnarin *et al*, 2011; Rezali

Table 3
Descriptive data of overweight and obesity by country and sex in school-going adolescents (13-15 years of age).

| Country | Obese | | | Overweight or obese | | |
|--------------------------------|---------------------|-------------------|--------------------|---------------------|-------------------|--------------------|
| | Total % (95% CI) | Boy % (95% CI) | Girl % (95% CI) | Total % (95% CI) | Boy % (95% CI) | Girl % (95% CI) |
| Brunei Darussalam ^a | 17.7 (15.8-19.8) | 20.4 (17.7-23.4) | 15.3 (12.7-18.2) | 36.1 (33.6-38.6) | 37.4 (34.1-40.8) | 34.8 (31.3-38.5) |
| Cambodia | 0.4 (0.3-0.5) | 0.5 (0.2-1.2) | 0.3 (0.1-1.0) | 3.7 (2.4-5.6) | 3.4 (1.9-5.9) | 4.0 (2.6-6.1) |
| Indonesia | 1.3 (0.8-1.9) | 1.5 (1.1-2.1) | 1.0 (0.5-2.1) | 7.0 (4.8-10.0) | 9.3 (6.2-13.8) | 4.9 (3.4-7.0) |
| Malaysia | 9.6 (9.0-10.3) | 11.4 (10.5-12.3) | 8.0 (7.2-8.9) | 23.7 (22.7-24.7) | 25.3 (23.8-26.9) | 22.2 (20.8-23.6) |
| Myanmar | 0.4 (0.1-1.0) | 0.5 (0.2-1.6) | 0.2 (0.1-0.8) | 3.4 (2.2-5.3) | 2.9 (1.1-5.7) | 3.9 (2.6-5.9) |
| Philippines | 2.8 (1.8-4.1) | 3.1 (1.8-5.2) | 2.5 (1.6-3.8) | 10.2 (7.6-13.6) | 11.3 (7.6-16.4) | 9.3 (7.2-11.9) |
| Thailand | 2.2 (1.6-2.9) | 2.4 (1.8-3.1) | 2.0 (1.3-2.9) | 8.9 (7.4-10.6) | 10.8 (8.9-13.0) | 7.1 (5.8-8.8) |
| Vietnam | 0.6 (0.3-1.4) | 1.3 (0.6-3.1) | 0.0 | 6.1 (4.3-8.5) | 8.3 (5.5-12.3) | 4.3 (2.9-6.1) |

^aCDC (2014).

et al, 2012; Mo-Suwan *et al*, 2014; Su *et al*, 2014), but appear to be lower than in low and middle income countries (12.9% among boys and 13.4% among girls) and high income countries (22.6% among girls and 23.8% among boys) (Ng *et al*, 2014). As reported in previous studies (Philipson and Posner, 2003; Popkin *et al*, 2012), this study found a strong positive association between higher country income level (Malaysia and Thailand) and overweight or obesity. In addition, there was a positive association between higher socioeconomic status (expressed as having no hunger) and overweight or obesity. This finding concurs with previous studies in other developing countries, such as Indonesia, Peru, South Asian nations, and Vietnam (Collins *et al*, 2008; Tang *et al*, 2010; Wang and Lim, 2012; Nguyen *et al*, 2013; Carrillo-Larco *et al*, 2015; Mistry and Puthussery, 2015). The higher prevalence of overweight or obesity among participants from higher socioeconomic levels and higher country income levels may be attributed to greater degrees of rapid social change and accompanied sociocultural influences related to physical activity and dietary pattern (Poskitt, 2014).

Overall, the study found that the prevalence of overweight or obesity was higher among boys than among girls, which concurs with previous studies in developing countries (Nichols and Cado-gan, 2009; Garza *et al*, 2011), including Thailand (Jitnarin *et al*, 2011) and Vietnam (Tang *et al*, 2010; Nguyen *et al*, 2013), and in most high income countries in Europe (Haug *et al*, 2009). Looking at gender differences in relation to prevalence of overweight or obesity in the individual study countries, only in the two upper middle income countries (Malaysia and Thailand) did boys have a significantly higher prevalence of overweight

Table 4
Descriptive statistics of independent variables associated with overweight or obesity
in school-going adolescents.

| Variable | Total number (%) | Overweight or obese | | |
|--|---------------------|---------------------|--------------|--------------|
| | | Total (%) | Boy (%) | Girl (%) |
| Socio-demographics | | | | |
| Age (years) | | | | |
| 13 | 9,130 (25.8) | 1,671 (13.6) | 905 (16.4) | 766 (11.1) |
| 14 | 10,972 (39.2) | 1,663 (9.0) | 909 (11.6) | 754 (6.7) |
| 15 | 10,182 (34.9) | 1,489 (8.2) | 748 (8.2) | 741 (8.1) |
| Country income | | | | |
| Low income/Lower middle income | 11,966 (39.5) | 754 (7.4) | 367 (8.9) | 387 (6.1) |
| Upper middle income | 18,318 (60.5) | 4,069 (17.6) | 2,195 (19.7) | 1,874 (15.6) |
| Dietary behavior and substance use | | | | |
| One or more carbonated soft drinks per day ^a | 7,645 (38.0) | 1,194 (10.1) | 677 (11.9) | 517 (8.3) |
| Fast foods times per week ^a | | | | |
| 0 | 12,870 (60.2) | 2,287 (9.2) | 1,227 (11.0) | 1,060 (7.5) |
| 1 | 7,011 (23.4) | 1,409 (12.6) | 742 (14.5) | 667 (11.1) |
| 2 or more times | 3,283 (16.4) | 565 (12.4) | 284 (13.2) | 281 (11.6) |
| Fruits (≥2 servings) | 12,694 (40.6) | 2,276 (10.6) | 1,212 (13.2) | 1,064 (8.4) |
| Vegetables (≥3 servings) | 8382 (27.0) | 1,574 (12.4) | 899 (15.4) | 1,657 (9.7) |
| Hunger | | | | |
| Never | 12,658 (43.1) | 1,932 (10.9) | 980 (13.3) | 952 (8.9) |
| Rarely | 7,876 (25.3) | 1,420 (10.4) | 768 (11.7) | 652 (9.1) |
| Sometimes/mostly/always | 9,663 (31.6) | 1,461 (8.1) | 809 (9.3) | 652 (6.8) |
| Current tobacco use | 2,661 (8.8) | 431 (10.9) | 370 (10.6) | 61 (12.1) |
| Current alcohol use | 2,337 (11.9) | 362 (10.8) | 246 (11.8) | 116 (9.2) |
| Physical activity | | | | |
| Physical activity less than 60 min per day on at least five days per week | 23,590 (80.4) | 3,742 (9.7) | 1,871 (11.6) | 1,871 (8.2) |
| Walk/bike to school in the past 7 days | | | | |
| 0 | 12,609 (37.0) | 2,211 (12.5) | 1,188 (14.8) | 1,023 (10.3) |
| 1-6 | 10,066 (32.1) | 1,595 (10.1) | 787 (10.8) | 808 (9.5) |
| 7 | 7,472 (30.9) | 1,008 (6.7) | 581 (8.6) | 427 (5.1) |
| Sitting (≥ 3 hours/day) | 10,896 (33.0) | 2,037 (12.4) | 1,060 (15.2) | 977 (10.1) |
| Physical education ^a | | | | |
| 0 day/week | 2,980 (12.3) | 444 (10.4) | 267 (11.3) | 177 (9.2) |
| 1 day/week | 9,277 (36.0) | 1,815 (13.0) | 922 (15.6) | 893 (10.9) |
| 2 or more days/week | 10,779 (51.6) | 1,981 (8.9) | 1,050 (10.1) | 931 (7.9) |
| Psychosocial factors | | | | |
| No close friends (base = yes) | 957 (3.2) | 153 (14.7) | 96 (19.1) | 57 (8.2) |
| Loneliness (base = no) | 2,396 (9.7) | 388 (9.7) | 187 (11.5) | 201 (8.5) |
| Suicidal ideation (base = no) | 2,325 (10.3) | 362 (9.9) | 154 (12.5) | 208 (8.4) |
| Bullied | 7,648 (35.6) | 1,114 (10.0) | 641 (11.0) | 473 (9.0) |
| Social-familial factors | | | | |
| Peer support (mostly/always) | 12,024 (40.4) | 2,014 (10.4) | 843 (11.0) | 1,181 (9.0) |
| Parental/guardian support index | | | | |
| 0 | 11,177 (39.9) | 1,825 (10) | 990 (12.0) | 835 (8.1) |
| 1 | 7,929 (26.8) | 1,332 (9.4) | 725 (11.3) | 607 (7.7) |
| 2-3 | 9,034 (33.3) | 1,525 (10.6) | 767 (12.0) | 758 (9.4) |

^aFor Cambodia, Malaysia, Philippines and Vietnam only.

Table 5
 Association between overweight or obesity prevalence, health behavior, mental health and protective factor variables in school-going adolescents by gender from 7 ASEAN study countries.

| Variable | Boy | | Girl | |
|--|---------------------|---------------------|---------------------|---------------------|
| | UOR (95% CI) | AOR (95% CI) | UOR (95% CI) | AOR (95% CI) |
| Socio-demographics | | | | |
| Age (years) | | | | |
| 13 | 1.00 | 1.00 | 1.00 | 1.00 |
| 14 | 0.67 (0.51-0.87)** | 0.71 (0.54-0.95)* | 0.58 (0.46-0.72)*** | 0.66 (0.52-0.84)*** |
| 15 | 0.46 (0.34-0.62)*** | 0.53 (0.39-0.72)*** | 0.71 (0.56-0.90)** | 0.82 (0.64-1.06) |
| Country income | | | | |
| Low income/Lower middle income | 1.00 | 1.00 | 1.00 | 1.00 |
| Upper middle income | 2.52 (1.91-3.33)*** | 1.99 (1.53-2.60)*** | 2.83 (2.25-3.56)*** | 2.43 (1.88-3.13)*** |
| Dietary behavior and substance use | | | | |
| One or more carbonated soft drinks per day ^a | 0.99 (0.70-1.39) | --- | 0.89 (0.69-1.16) | --- |
| Fast food (times per week) ^a | | | | |
| 0 | 1.00 | --- | 1.00 | 1.00 ^b |
| 1 | 1.37 (0.98-1.93) | --- | 1.53 (1.2-1.93)*** | 1.21 (0.95-1.54) |
| 2 or more times | 1.23 (0.67-2.26) | | 1.61 (1.28-2.04)*** | 1.44 (1.09-1.89)* |
| Fruits (≥ 2 servings) (base = < 2 servings) | 1.31 (1.11-1.54)*** | 1.16 (0.96-1.39) | 1.02 (0.86-1.20) | --- |
| Vegetables (≥ 3 servings) (base = < 3 servings) | 1.61 (1.35-1.91)*** | 1.34 (1.09-1.65)** | 1.25 (1.01-1.55)* | 1.13 (0.89-1.43) |
| Hunger | | | | |
| Never | 1.00 | 1.00 | 1.00 | 1.00 |
| Rarely | 0.86 (0.68-1.12) | 0.85 (0.65-1.11) | 1.03 (0.79-1.34) | 1.06 (0.80-1.40) |
| Sometimes/mostly/always | 0.67 (0.53-0.85)*** | 0.67 (0.52-0.85)*** | 0.75 (0.62-0.90)** | 0.72 (0.58-0.90)** |
| Current tobacco use (base = no) | 0.89 (0.71-1.11) | --- | 1.55 (1.05-2.29)* | 1.62 (1.03-2.56)* |
| Current alcohol use (base = no) | 1.03 (0.79-1.34) | --- | 1.12 (0.82-1.53) | --- |
| Physical activity | | | | |
| Physical activity less than 60 min per day on at least 5 days per week (base = 5-7 days) | 0.99 (0.80-1.22) | --- | 0.86 (0.68-1.10) | --- |

Table 5 (Continued).

| Variable | Boy | | Girl | |
|--|---------------------|---------------------|---------------------|---------------------|
| | UOR (95% CI) | AOR (95% CI) | UOR (95% CI) | AOR (95% CI) |
| Walk/bike to school in the past 7 days | | | | |
| 0 | 1.00 | 1.00 | 1.00 | 1.00 |
| 1-6 | 0.70 (0.56-0.86)*** | 0.73 (0.59-0.90)** | 0.91 (0.75-1.11) | 1.04 (0.84-1.28) |
| 7 | 0.54 (0.42-0.70)*** | 0.68 (0.54-0.87)** | 0.47 (0.37-0.59)*** | 0.67 (0.51-0.87)** |
| Sitting (≥ 3 hours/day) | 1.63 (1.36-1.96)*** | 1.57 (1.28-1.93)*** | 1.38 (1.14-1.67)*** | 1.28 (1.05-1.57)* |
| Physical education ^a | | | | |
| 0 day/week | 1.00 | --- | 1.00 | --- |
| 1 day/week | 1.45 (0.88-2.39) | --- | 1.21 (0.87-1.67) | --- |
| 2 or more days/week | 0.88 (0.55-1.40) | --- | 0.85 (0.64-1.12) | --- |
| Psychosocial factor | | | | |
| No close friends (base = yes) | 1.85 (1.28-2.68)*** | 1.89 (1.25-2.86)** | 0.99 (0.59-1.66) | --- |
| Loneliness (base = no) | 1.00 (0.70-1.43) | --- | 1.02 (0.79-1.31) | --- |
| Suicidal ideation (base = no) | 1.12 (0.80-1.57) | --- | 1.02 (0.76-1.37) | --- |
| Bullied | 0.92 (0.77-1.10) | --- | 1.19 (1.00-1.41)* | 1.43 (1.18-1.73)*** |
| Social-familial factor | | | | |
| Peer support (mostly/always) | 0.97 (0.78-1.21) | --- | 1.27 (1.09-1.48)** | 1.30 (1.12-1.52)*** |
| Parental/guardian support index | | | | |
| 0 | 1.00 | --- | 1.00 | --- |
| 1 | 0.93 (0.73-1.18) | --- | 0.95 (0.76-1.18) | --- |
| 2-3 | 1.00 (0.81-1.23) | --- | 1.18 (0.96-1.44) | --- |

^aFor Cambodia, Malaysia, Philippines and Vietnam only. ^bIncluded in model after previous model including all study countries excluded this variable. AOR, adjusted odds ratio; CI, confidence interval; UOR, unadjusted odds ratio. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

or obesity than girls, while in all other study countries, including high income country Brunei Darussalam, there are no significant gender differences. This may be attributed to difference in transit to pubescence whereby boys may be more susceptible to overweight than girls as has been reported in lower middle income and upper middle income countries (Poskitt, 2014), but other factors must be involved. Furthermore, this study found that younger adolescent school children (13 years) were more likely to be overweight or obese than 14 or 15 year-olds, as shown in previous studies (Tang *et al*, 2010; Garza *et al*, 2011).

Regarding dietary behavior and substance use, the findings of study, among girls, were in agreement with a survey (Moreno and Rodríguez, 2007) demonstrating an association between frequent consumption of fast food. However among boys, Ntalla *et al* (2016) indicated that adequate vegetable consumption is associated with overweight or obesity, supporting earlier studies [reviewed by Keller and Bucher Della Torre (2015)]. This study did not find an association between consumption of sugar-sweetened beverages and overweight or obesity. In agreement with Potter *et al* (2004) and Peltzer and Pengpid (2011), this study confirmed an association between tobacco use and overweight or obesity among girls. It is possible that girls entertain the belief that smoking could control their body weight (Potter *et al*, 2004).

Although this investigation did not find a correlation between physical inactivity and overweight or obesity, not walking or biking to school and high sedentary behavior were, however, associated with overweight or obesity, as also found in some previous studies in

South Asia, Malaysia and Thailand (Mo-Suwan *et al*, 2014; Teo *et al*, 2014; Mistry and Puthussery, 2015). Contrary to some previous studies (*eg*, So *et al*, 2011), this study did not find an association between non-participation in physical education classes and overweight or obesity.

In relation to psychosocial factors, indicators such as having no close friends among boys and being bullied among girls, as reported in an earlier review (Vámosi *et al*, 2010), were found to be associated with overweight or obesity. The relevance of relating psychosocial stressors and childhood obesity has been emphasized (Gundersen *et al*, 2011). Positive peer support among girls was found, as in a previous study (Pengpid and Peltzer, 2015), to be associated with overweight or obesity. It is possible that socio-cultural values of body size among girls contribute to this. Parental life style seems in this study not to have any influence on body weight in the adolescents studied, unlike a previous study (Kakinami *et al*, 2015).

The strength of using the GSHS was the utilization of standardized methods and questionnaires across the 7 ASEAN countries. However, as the study survey was cross sectional no causal inferences could be made. BMI was assessed by self-reported height and weight and in future studies should include anthropometry to evaluate weight studies.

In conclusion, high prevalence of overweight or obesity was found among school-going adolescents in seven ASEAN study countries. Increased strategies utilizing some of the risk factors identified are needed to prevent and treat overweight or obesity in adolescents in all ASEAN member states, in particular those moving rapidly through economic and health transitions.

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Conflict of interest

The authors declare they have no conflicts of interest. The governments of the respective study countries and the World Health Organization did not influence the analysis nor did they have an influence on the decision to publish these findings.

REFERENCES

- Atienza M. Trends of childhood obesity in ASEAN. *Southeast Asian J Trop Med Public Health* 2014; 45 (suppl 1): 149-52.
- Carrillo-Larco RM, Miranda JJ, Bernabé-Ortiz A. Wealth index and risk of childhood overweight and obesity: evidence from four prospective cohorts in Peru and Vietnam. *Int J Public Health* 2015 Nov 24.
- Centers for Disease Control (CDC). State indicator report on fruits and vegetables. Atlanta: CDC, 2013. [Cited 2015 Dec 10]. Available at: <http://www.cdc.gov/nutrition/downloads/state-indicator-reportfruits-vegetables-2013.pdf>
- Centers for Disease Control (CDC). Global School-based Student Health Survey. Brunei Darussalam. Atlanta: CDC, 2014 Fact Sheet. [Cited 2015 Dec 10]. Available from: http://www.who.int/chp/gshs/Brunei_Darussalam_2014_FactSheet.pdf
- Centers for Disease Control (CDC). The Global School and Health Survey background. Atlanta: CDC, 2015. [Cited 2015 Dec 18]. Available from: <http://www.cdc.gov/gshs/background/index>
- Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 2000; 6, 320: 1240-3.
- Collins AE, Pakiz B, Rock CL. Factors associated with obesity in Indonesian adolescents. *Int J Pediatr Obes* 2008; 3: 58-64.
- De Onis M, Lobstein T. Defining obesity risk status in the general childhood population: which cut-offs should we use? *Int J Pediatr Obes* 2010; 5: 458-60.
- Garza JR, Pérez EA, Preliop M, et al. Occurrence and correlates of overweight and obesity among island Puerto Rican youth. *Ethn Dis* 2011; 21: 163-9.
- Gundersen C, Mahatmya D, Garasky S, Lohman, B. Linking psychosocial stressors and childhood obesity. *Obes Rev* 2011;12: e54-63.
- Guthold R, Cowan MJ, Autenrieth CS, Kann L, Riley LM. Physical activity and sedentary behavior among schoolchildren: a 34-country comparison. *J Pediatr* 2010; 157: 43-49.e1.
- Haug E, Rasmussen M, Samdal O, et al. Overweight in school-aged children and its relationship with demographic and lifestyle factors: results from the WHO-Collaborative Health Behaviour in School-aged Children (HBSC) study. *Int J Public Health* 2009; 54: 167-79.
- Kakinami L, Barnett TA, Séguin L, Paradis G. Parenting style and obesity risk in children. *Prev Med* 2015; 75: 18-22.
- Keller A, Bucher Della Torre S. Sugar-sweetened beverages and obesity among children and adolescents: A review of systematic literature reviews. *Child Obes* 2015; 11: 338-46.
- Jaacks LM, Slining MM, Popkin BM. Recent trends in the prevalence of under- and

- overweight among adolescent girls in low- and middle-income countries. *Pediatr Obes* 2015 Dec; 10: 428-35.
- Jitnarin N, Kosulwat V, Rojroongwasinkul N, Boonpradern A, Haddock CK, Poston WS. Prevalence of overweight and obesity in Thai population: results of the National Thai Food Consumption Survey. *Eat Weight Disord* 2011; 16: e242-9.
- Lobstein T, Jackson-Leach R, Moodie ML, *et al.* Child and adolescent obesity: Part of a bigger picture. *Lancet* 2015; 385: 2510-20.
- Mistry SK, Puthussery S. Risk factors of overweight and obesity in childhood and adolescence in South Asian countries: a systematic review of the evidence. *Public Health* 2015; 129: 200-9.
- Moreno LA, Rodríguez G. Dietary risk factors for development of childhood obesity. *Curr Opin Clin Nutr Metab Care* 2007; 10: 336-41.
- Mo-Suwan L, Nontarak J, Aekplakorn W, Sath-eannoppakao W. Computer game use and television viewing increased risk for overweight among low activity girls: Fourth Thai National Health Examination Survey 2008-2009. *Int J Pediatr* 2014; 2014: 364702.
- Ntalla I, Yannakoulia M, Dedoussis GV. An overweight preventive score associates with obesity and glycemic traits. *Metabolism* 2016; 65: 81-8.
- Ng M, Fleming T, Robinson M, *et al.* Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2014; 384: 766-81.
- Nguyen PV, Hong TK, Hoang T, Nguyen DT, Robert AR. High prevalence of overweight among adolescents in Ho Chi Minh City, Vietnam. *BMC Public Health* 2013; 13: 141.
- Nichols SD, Cadogan F. BMI-based obesity cutoffs and excess adiposity in a Caribbean adolescent population of African origin. *Eur J Clin Nutr* 2009; 63: 253-8.
- Peltzer K, Pengpid S. Overweight and obesity and associated factors among school-aged adolescents in Ghana and Uganda. *Int J Environ Res Public Health* 2011; 8: 3859-70.
- Pengpid S, Peltzer K. Overweight and obesity and associated factors among school-aged adolescents in six Pacific Island countries in Oceania. *Int J Environ Res Public Health* 2015; 12: 14505-18.
- Philipson TJ, Posner RA. The long-run growth in obesity as a function of technological change. *Perspect Biol Med* 2003; 46: S87-107.
- Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. *Nutr Rev* 2012; 70: 3-21.
- Poskitt EME. Childhood obesity in low- and middle-income countries. *Paediatr Intern Child Health* 2014; 34: 239-49.
- Potter BK, Pederson LL, Chan SS, Aubut JA, Koval JJ. Does a relationship exist between body weight, concerns about weight, and smoking among adolescents? An integration of the literature with an emphasis on gender. *Nicotine Tob Res* 2004; 6: 397-425.
- Prochaska JJ, Sallis JF, Long B. A physical activity screening measure for use with adolescents in primary care. *Arch Pediatr Adolesc Med* 2001; 155: 554-9.
- Rampal L, Rampal S, Khor GL, *et al.* A national study on the prevalence of obesity among 16,127 Malaysians. *Asia Pac J Clin Nutr* 2007; 16: 561-6.
- Rezali FW, Chin YS, Mohd Yusof BN. Obesity-related behaviors of Malaysian adolescents: a sample from Kajang district of Selangor state. *Nutr Res Pract* 2012; 6: 458-65.
- Rerksuppaphol S, Rerksuppaphol L. Prevalence of overweight and obesity among school children in suburb Thailand defined by the International Obesity Task Force Standard. *J Med Assoc Thai* 2010; 93 (suppl 2): S27-31.
- Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: Systematic review. *Int J Obes* 2011; 35: 891-8.

- So WY, Sung DJ, Swearingin B, *et al.* Prevalence of obesity in Korean adolescents and its relationship with the weekly frequency of the physical education classes. *J Sports Sci Med* 2011; 10: 679-84.
- Su TT, Sim PY, Nahar AM, *et al.* Association between self-reported physical activity and indicators of body composition in Malaysian adolescents. *Prev Med* 2014; 67: 100-5.
- Tang HK, Dibley MJ, Sibbritt D, Tran HM. Gender and socio-economic differences in BMI of secondary high school students in Ho Chi Minh City. *Asia Pac J Clin Nutr* 2007; 16: 74-83.
- Tang KH¹, Nguyen HH, Dibley MJ, Sibbritt DW, Phan NT, Tran TM. Factors associated with adolescent overweight/obesity in Ho Chi Minh City. *Int J Pediatr Obes* 2010; 5: 396-403.
- Teo PS, Nurul-Fadhilah A, Aziz ME, Hills AP, Foo LH. Lifestyle practices and obesity in Malaysian adolescents. *Int J Environ Res Public Health* 2014; 11: 5828-38.
- The World Bank. Countries and economies. Washington: The World Bank, 2015. [Cited 2015 Dec 28]. Available from: <http://data.worldbank.org/country/>
- The World Bank. Urban population (% of total). Washington: The World Bank, 2016. [Cited 2015 Dec 28]. Available from: <http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS>
- Trang NH, Hong TK, Dibley MJ. Cohort profile: Ho Chi Minh City Youth Cohort--changes in diet, physical activity, sedentary behaviour and relationship with overweight/obesity in adolescents. *BMJ Open* 2012; 2(1): e000362.
- Vámosi M, Heitmann BL, Kyvik KO. The relation between an adverse psychological and social environment in childhood and the development of adult obesity: a systematic literature review. *Obes Rev* 2010; 11: 177-84.
- Wang Y, Lim H. The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. *Int Rev Psychiatry* 2012; 24: 176-88.